Space Weather Technical Forecast

Issued on Thursday, 18 July 2024 at 13:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares expected. Chance of G1 Minor Storms late day 2 or more likely day 3 (19-20 Jul) due to CME arrival

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity with multiple M-flares observed, with the largest a multi-peaking M2.2 at 18/1014 UTC from AR3751 in the southeast disc. This is the most complex region on the disc, and has continued to show some slow growth and development, including a couple of small delta spots. There are a total of seventeen sunspot regions currently on the Earth-facing disc, however these are generally small and simpler than AR3751, with little growth or some decay. The exceptions are the relatively newly numbered AR3759, AR3760 in the centre and north-centre disc, along with some recent growth south of AR3573 in the northwest.

No Earth-directed CME's have been observed, however it is too soon to assess if the M2.2 flare generated one.

Solar Wind / Geomagnetic Activity: Slow wind conditions persisted. The solar wind speed, as measured by ACE at L1, was at background, around 350 km/s. Density was average or below. Interplanetary magnetic field (IMF), Bt, was Weak, ranging 1-6nT with its north-south component (Bz), variable between +5/-5nT, but favouring a positive orientation (northward). Phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet throughout (Kp 1-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels. The 24-hour fluence was below Active, with 1.01e6 integrated pfu observed at 18/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected with further M-class flares. These most likely from AR3751 on the southeast disc, but perhaps also AR3738 from over the southwest limb on day 1 (18 Jul). Isolated flares are possible from across the disc, however, given the preponderance of sunspots.

Solar Wind /Geomagnetic Activity: The CMEs from the M1.9 flare at 16/2206 UTC are expected to arrive either late on day 2 or early day 3 (19-20 Jul). Any fast wind from CH54/- is most likely to remain north of Earth, but with the potential for slight enhancements day 1-2 (18-19 Jul) with a chance of brief spells of slightly elevated winds. Mainly Quiet geomagnetic activity is expected overall, but brief Unsettled to Active enhancements are possible day 1-2 (18-19 Jul) from any fast wind interaction, and Active to G1 Minor Storm intervals day 2-3 (19-20 Jul) with any CME arrival.

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels, but with chance of rising above the S1/Minor Storm threshold in response to any notable flares, most likely from AR3738 before continuing to recede beyond the west limb, but with this risk sustained due to developing AR3751 as this moves towards and into the western hemisphere. High energy electron flux is expected to remain at background, perhaps rising to Moderate briefly due to any fast wind connection, but likely suppressed again with any

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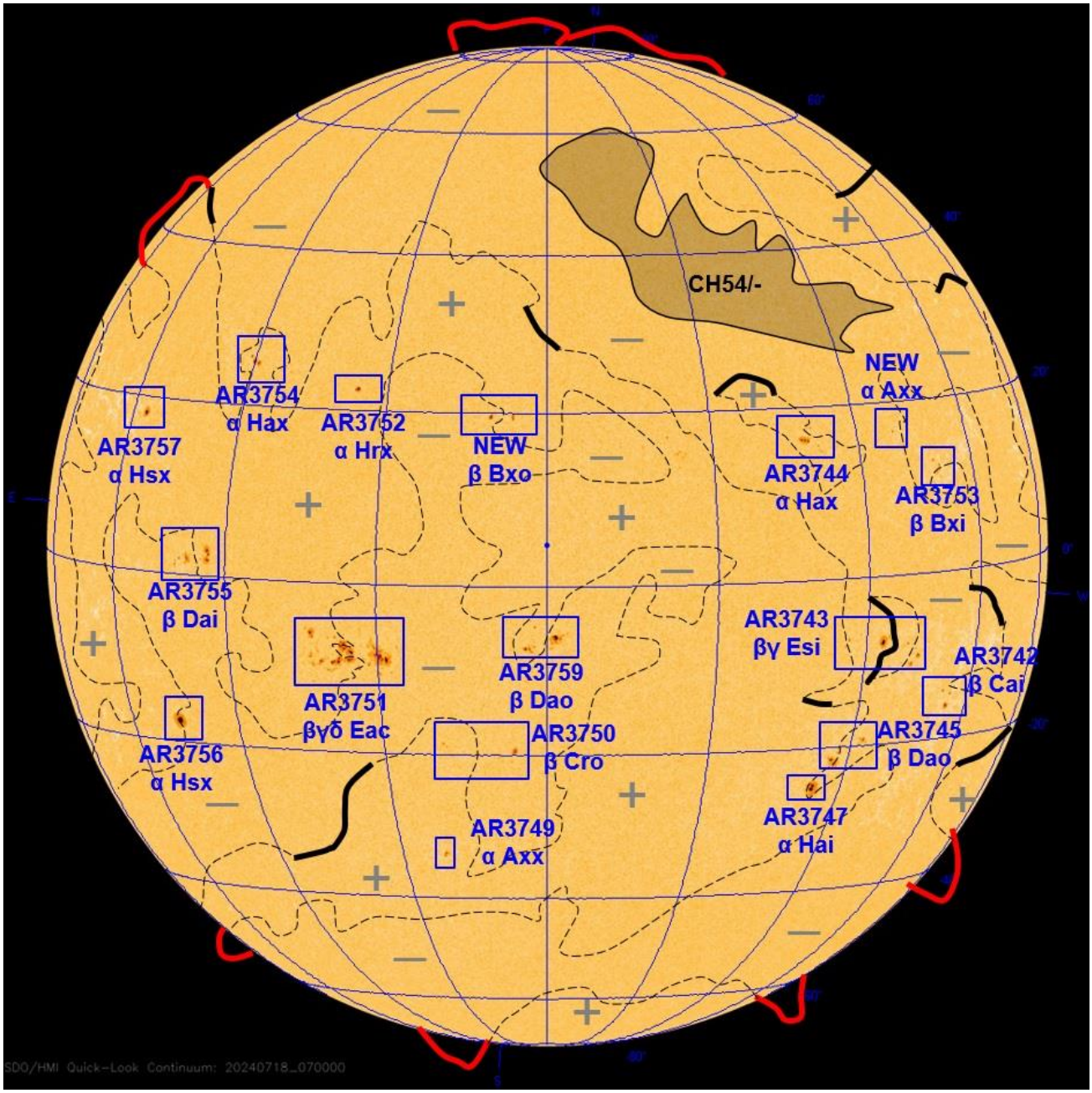
CME arrival. The associated 24 hr fluence is expected to below the Active level.

Figure 1. Solar Analysis Valid 18/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

An M1.6 flare from AR3753 peaking at 16/2123 UTC in the northwest disc, was followed by an M1.9 flare from AR3744 at 16/2206 UTC. A subsequent double CME was observed, although it appears likely these were both from the second of these flares, with a main material ejecta to the northeast. This was followed with a very weak asymmetric halo CME which is possibly mostly shock, but has not been discounted for some material content. These are expected to arrive either late on day 2 (19 Jul) or more likely early day 3 (20 Jul), although the second and slow of these CMEs may be imperceptible on arrival on 20 Jul.

The fast wind from CH54/- remains an uncertain component of the forecast, having not been observed, but yet indicated in MOSOWC Enlil to have influence the solar wind environment around Earth since early on 17 Jul. Brief forays into this wind may bring some slight enhancement day 1 or 2 (18-19 Jul), but otherwise the geomagnetic forecast is dominated by slow wind conditions, along with the potential CME arrival.

Geomagnetic activity is expected to be mostly Quiet to Unsettled, but with a slight chance of Active intervals days 1-2 (18-19 Jul) should any fast wind enhancement from CH54/- be observed. Any CME arrival is then expected to increase activity to Active with likelihood of G1 Minor Storm intervals, most likely on day 3 (20 Jul). Any CME effects gradually waning later day 3 and day 4 (21 Jul), with mainly Quiet conditions returning.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	60	5
Strong	G3	No	1	1	2	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
17/0334	Nil	M1.9 16/2206 AR3744	N-Centre	691 km/s	19/2200 -6hrs/+12 hrs	Main CME ejecta. Limited shock expected
17/0400	Asymmetric Halo	M1.9 16/2206 AR3744	N-Centre	530 km/s	20/1000 +/- 10 hrs	Faint Halo, probably mainly shock. May not be observable

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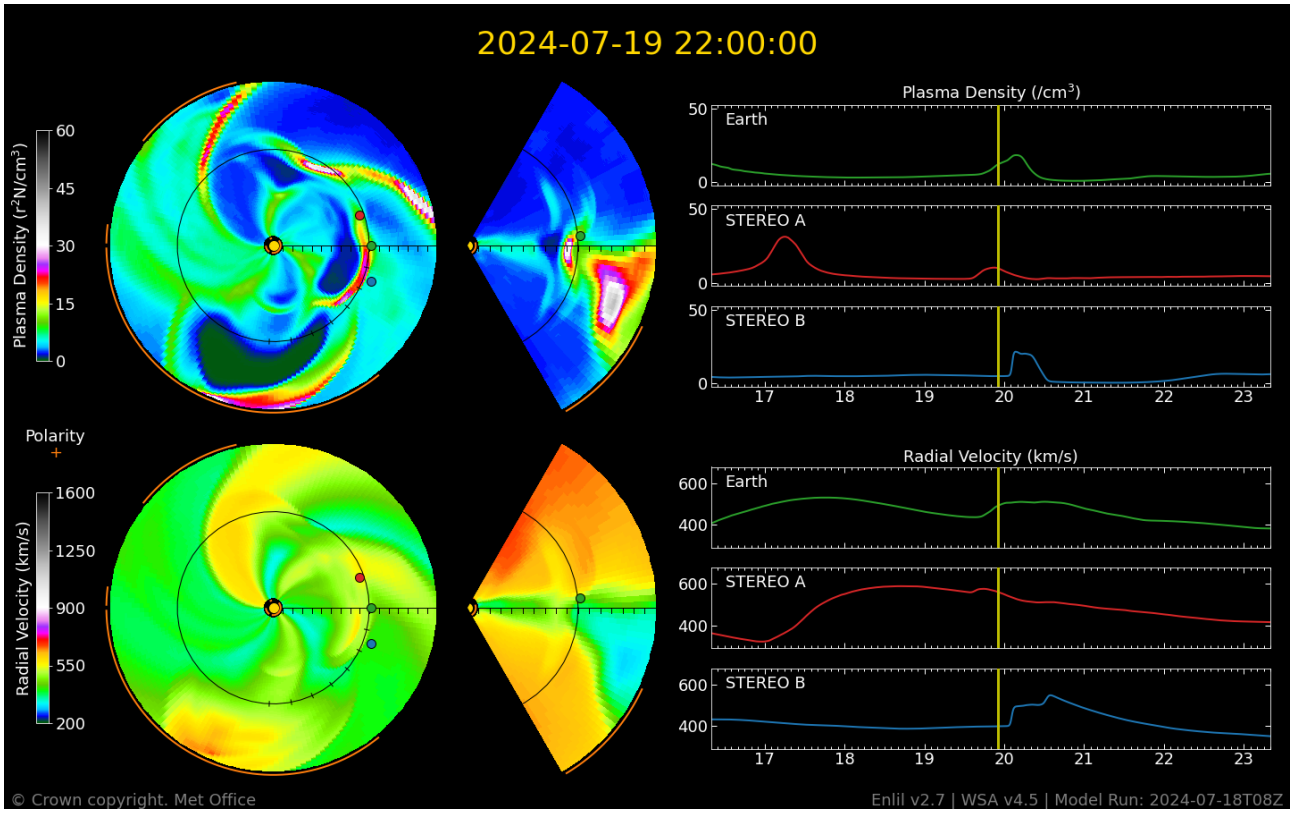
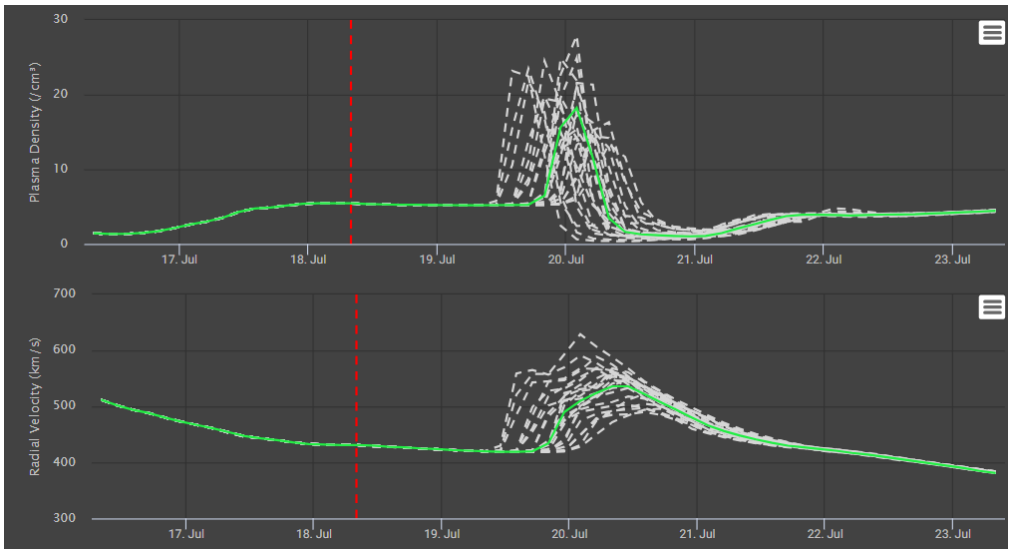
Figure 2: Enlil showing the likely arrival 19/2200 UTC.





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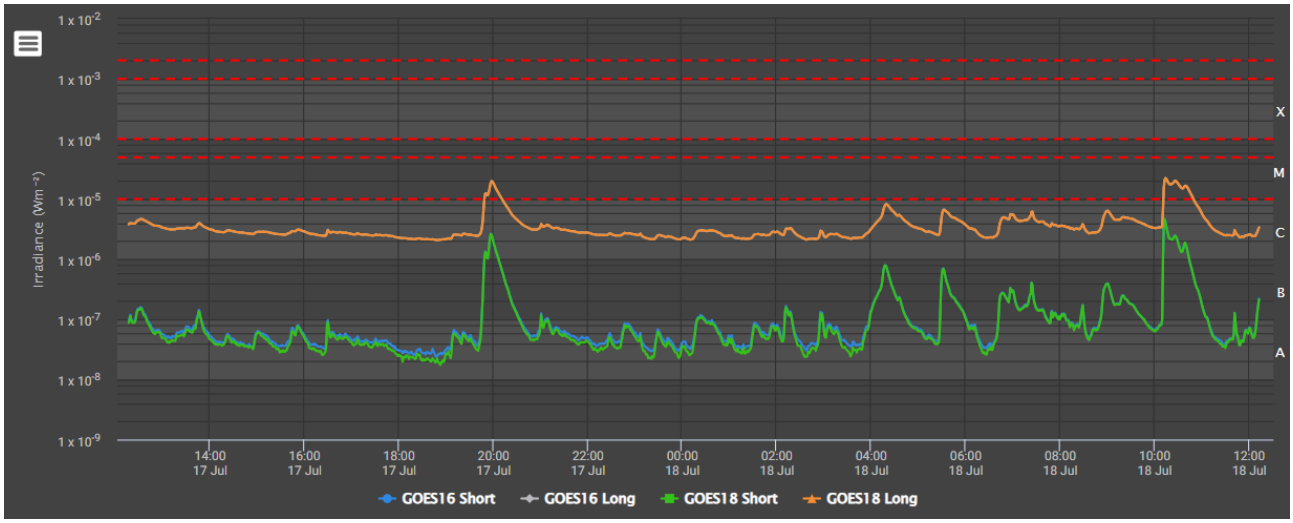
Radio Blackouts - X-Ray Flares:

Moderate activity is expected with a slight chance of X-class flares.

There are seventeen regions on the disc. Of the visible regions, AR3751 is the largest and most complex, with a couple of moderately strong delta spots within its intermediate region and a slow growth trend. The other regions across the disc, are generally smaller and simple with many showing slow weakening or only limited growth. The exceptions are the newer regions in the north-centre disc, including the recently numbered AR3760 and AR3759, and to the south of AR3753 in the northwest. These regions have all shown some limited growth, but currently remain simple. Some magnetic looping and brightness also remains evident from AR3738 from over the southwest limb, and this still provides some potential for observable flares, albeit quickly receding through the coming hours.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	75	70	70
Very Active	R3 to R5 X Class	No	15	10	10	10

Figure 3:



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at background. There is a chance of proton flux increasing given any significant flares from just over the southwest limb, due to AR3738, with a slight chance of reaching the S1 Minor Radiation Storm level. Despite the number of sunspot regions on the disc, these are generally smaller and simpler, with the possible exception of AR3751 which will also maintain this slight solar radiation storm chance through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux as observed by GOES-16 is expected to remain at background. Any subsequent fast wind connection may lead to flux rising to give spells of Moderate day 2 (19 Jul), however any increase is likely to quickly be suppressed by the onset of any CME arrival later that day or on day 3 (20 Jul).

The associated electron fluence is expected to persist below the Active level with MOSWOC REFM currently providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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